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WATERFOWL PRODUCTION IN RELATION TO GRAZING

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Abstract: A 4-year production study of upland nesting waterfowl on the Missouri Coteau area of North Dakota showed that pair numbers, nesting densities and nest success were generally reduced by grazing. It is suggested that cover removal such as regular grazing and mowing be discontinued on areas managed primarily for waterfowl production and that management practices which create dense rank cover be substituted.

Wetland drainage is rapidly reducing waterfowl production in the prairie pothole region of North America where Smith et al. (1964) estimated that half of the continental duck population is produced in an average year. Efforts to preserve prairie wetlands include programs of Federal, state, and provincial governments and private conservation organizations in the United States and Canada. Despite these efforts, an average of 138,000 acres are drained each year in the Dakotas and Minnesota (Morgan 1969).

A less obvious but no less harmful loss of waterfowl production in prairie areas results from changes in agricultural land use. This is especially true on private lands where potholes remain but lack of nesting cover may be seriously inhibiting production (Dwyer 1969).

This paper presents the results of a 4-year study from 1965 through 1968 on the relationship of waterfowl production to land use, with emphasis on grazing. Its purpose is to provide habitat management guidelines for increasing waterfowl production.

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STUDY AREA

The Woodworth Study Area is situated in northwestern Stutsman County, North Dakota, in the Missouri Coteau physiographic area. Land use on the 3,840-acre study area is primarily diversified farming. The approximate acreages in each land-use category during the study were: pasture—1,360; cropland—770; "idle land"—740 (not grazed or mowed); and hayland—240. Wetlands covered from 250–570 acres. Building sites, roads, railroad rights-of-way, and shelterbelts totaled about 160 acres.

The 610 wetland basins on the study area covered about 592 acres and had widely varied characteristics. Their size ranged from a fraction of an acre to slightly more than 53 acres and averaged 0.92 acre. The depth of some is regulated by natural spillways while others seldom, if ever, overflowed. Maximum water depths ranged from a few inches to over 10 ft. A few contained fresh water but the majority were slightly to moderately brackish.

Pasture and idle lands were either native grassland containing exotic grasses and forbs, or tame mixtures of bromegrass (*Bromus inermis*), quackgrass (*Agropyron repens*), and alfalfa (*Medicago sativa*). Hayland was either native grassland or alfalfa mixed with tame grasses. Scattered clumps of brush of the following genera are found on both idle and grazed native grasslands: *Symphoricarpus*, *Elaeagnus*, *Crataegus*, *Prunus*, and *Rosa*. Croplands were used for producing small grains. About one-quarter of the cropland was summer fallowed each year.

METHODS

Six plots ranging in size from 41 to 91 acres were selected for intensive nesting studies in 1967 and 1968. An attempt was made to minimize variables other than land-use by selecting plots having similar terrain, wetland distribution and classification, and upland vegetation. Characteristics of the plots are presented in Table 1.

Grazing intensity was judged by visual inspection of residual vegetation in the spring before the current year's growth began. Pastures with ⅔ or more of the previous year's growth remaining were classified as lightly grazed, those with ⅓ to ⅔ as moderately grazed, and those with less than ⅓ as heavily grazed. In terms of livestock use, lightly grazed plots were stocked at a rate of one cow per 9 to 15 acres or one animal unit month (A.U.M.) per 6 acres, moderately grazed plots at one cow per 5 to 8 acres (one A.U.M. per 1.35 acres), and heavily grazed plots at one cow per 2 to 4 acres (one A.U.M. per fraction of an acre).

Surveys of water areas and counts of waterfowl pairs were made at 10-day intervals between late April and late June. These were conducted by walking or driving to each wetland basin and recording pairs, lone males, lone females, and groups of each species. Duplication in counting was avoided by not flushing ducks or by watching them until they landed if they were flushed. Observation of pairs, lone drakes, or combinations indicative of pairs were used to estimate the breeding population (Hammond, unpublished instruction man-

Table 1. Characteristics of sample plots for waterfowl nest study, Woodworth Study Area, 1967-68.

PLOT NO.	UPLAND VEGETATION	LAND USE	UPLAND ACRES	WETLAND ACRES	NO. OF WETLAND BASINS	FEET OF SHORELINE
Grazed						
8	Native grassland and alfalfa-grass	Lightly grazed	60.5	30.9	22	13,185
7	Native grassland	Moderately to heavily grazed	35.0	6.7	19	5,200
11	Native grassland	Heavily grazed	68.0	11.3	33	11,930
		Total	163.5	48.9	74	30,315
Ungrazed						
5	Native grassland and alfalfa-grass	Idle	57.0	8.8	18	7,890
6	Native grassland	Idle	36.0	4.5	22	6,390
10	Native grassland	Idle	64.0	20.2	26	12,575
		Total	157.0	33.5	66	26,705

nal on file at the Northern Prairie Wildlife Research Center).

Four nest searches were made each year at approximately 2-week intervals from late May through July. Searching was done between 7:00 AM and 1:00 PM with the use of a cable-chain drag described by Higgins et al. (1969). Paired plots in ungrazed and grazed vegetation were searched either on the same or subsequent days.

All nests located were examined to determine species, stage of incubation, number of eggs, cover type, cover condition, and location with respect to water. Each nest was marked by a strip of colored tape or a surveyor's flag attached to vegetation or a stake 10 to 20 ft from the site. Nests were visited after calculated hatching dates to determine their fates.

Brood production was estimated on the basis of surveys of all water areas during mid-July and mid-August and augmented by incidental observations. The minimum number of broods was estimated by eliminating from the records all duplicate observations as indicated by species, date, location, age-class, and number of young.

Predator activity in and near drag tracks was monitored by clearing all vegetation from 3- × 3-ft plots and covering the exposed areas with about 3 inches of dirt sieved through ¼-inch hardware cloth. The plots were then smoothed and dusted with fine dirt sieved through window screen. Plots prepared in this manner were examined after 24 hours for evidence of predator activity.

RESULTS

Pair Populations

Pair populations of dabbling ducks, principally blue-winged teal (*Anas discors*), gadwall (*A. strepera*), mallard (*A. platyrhynchos*), shoveler (*Spatula clypeata*), and pintail (*A. acuta*) on grazed and ungrazed plots are compared in Table 2. An average of 21 pairs per 10,000 ft of shoreline was found on ungrazed plots and 15 pairs on grazed plots. The observed differences would have been greater if the population on plot 6 had not been especially low in 1968. This low population may have been caused by the presence of red foxes

Table 2. Numbers of pairs of dabbling ducks on sample plots during mid-May, Woodworth Study Area, 1967–68.

Plot No.	Number of Dabbler Pairs		Dabbler Pairs per 10,000 Ft of Shoreline		
	1967	1968	1967	1968	Average
Grazed					
8	18	12	13	11	12
7	11	8	22	18	20
11	15	9	15	9	12
Total	44	29	Avg. 17	13	15
Ungrazed					
5	18	15	28	23	26
6	12	5	19	8	14
10	25	30	20	25	23
Total	55	50	Avg. 22	19	21

(*Vulpes fulva*) which had a den on this 36-acre plot. Fox dens were not observed on or near other plots. No apparent relationships existed between grazing intensity and pair densities on the grazed plots.

Further evidence of the difference in pair populations on idle and grazed areas was obtained by comparing pair data for 100 additional Woodworth Study Area ponds from each of these land-use categories during 1967 and 1968. Ponds on grazed areas averaged 17 pairs compared to 21 pairs per 10,000 ft of shoreline on ponds in idle areas.

Similar observations have been made by other workers. Salyer (1962:40) studied pair use on 6 sections of land on or near the Lostwood National Wildlife Refuge in North Dakota. He observed approximately twice as many pairs on idle land as he did on similar units of moderately grazed or lightly grazed lands. Martz (1967:242) noted that activity of prenesting pairs was greater on unmowed than on mowed units in his North Dakota study area. Drewien (1968:39) found more pairs per pond in Soil Bank and other idle land in South Dakota than on hayed, cultivated, or grazed lands.

In addition to this effect of cover removal on breeding populations, pairs are apparently also disturbed by cattle and tend to move from areas where cattle graze or concentrate. In 1967, the pair population counted on plot 8 was 20 during the June 1–3 pair survey (Table 3). Cattle were placed in this plot on June 9, and only 9 pairs were found during the June 26–28 survey. Conversely, the pair population on plot 5, where cattle were excluded, was 21 during the first survey and 20 during the latter.

Table 3. Effect of cattle on numbers of pairs and nests of ducks, Woodworth Study Area, 1967.

Date	Plot 8—Cattle[a]		Plot 5—No Cattle	
	Pairs	Nests	Pairs	Nests
June 1–3	20	14	21	10
June 26–28	9	6	20	9
Percent change	−55	−57	−5	−10

[a] Twenty-one yearling cattle entered on June 9

The effects of disturbance by cattle were also reflected in nest densities on the above plots. There were 14 active nests on plot 8 during the first survey and 6 during the latter while on plot 5 nest densities were 10 and 9 during the first and latter survey, respectively. The change in nest density on plot 8 was not a result of nests hatching. Hammond (Personal communication) observed a similar reaction of breeding ducks to cattle on Lostwood and LaCreek National Wildlife refuges. He reported that female ducks tended to avoid sites where cattle were present during the prenesting period and when selecting nest sites. He noted a movement of females from potholes in pastures to those in surrounding ungrazed areas on Lostwood National Wildlife Refuge.

Nest Densities

Average nest densities on sample plots during 1967 and 1968 were 0.17 nest per

Table 4. Densities of duck nests on sample plots, Woodworth Study Area, 1967 and 1968.

Plot No.	No. Active Nests Found	Nests/Acre
Grazed		
8	30	0.23
7	8	0.09
11	22	0.16
Total	60	Average 0.17
Ungrazed		
5	34	0.26
6	25	0.34
10	30	0.23
Total	89	Average 0.28

acre on grazed plots and 0.28 nest per acre on ungrazed plots (Table 4). The lightly grazed plot had a higher nest density than the heavily or moderately grazed plots. The lowest nest density on idle plots was equal to the highest on grazed plots.

When comparing nest densities one should consider that the cable-chain drag was more efficient in grazed than in idle cover. Ninety percent of 10 previously located hens on nests were flushed when dragged over in grazed cover, while 67 percent of 15 hens were flushed by the drag in idle cover.

Other observers have reported high nest densities in idle cover. R. I. Benson in Moyle (1961:117) found undisturbed upland grassy areas and Soil Bank fields to be the most favored nesting sites for dabbling ducks in Minnesota. A density of 0.7 acre per nest was found by Keith (1961:65) on an ungrazed area in Alberta. Nest densities found on Valentine National Wildlife Refuge, Nebraska, by Campbell (Unpublished report on file at the Refuge) were from three to five times greater on idle than on grazed and mowed areas. Martz (1967: 244) found consistently higher nest densities on unmowed than on mowed areas at Lower Souris National Wildlife Refuge in North Dakota. In Iowa, "the heaviest concentration of [blue-winged] teal nests, one per 1.3 acres, was found on the 30-acre ungrazed island . . ." (Glover 1956:34). Ungrazed meadows, which made up 14 percent of the study area, accommodated 87 percent of the 593 nests found by Sowls (1955:67) during studies in Manitoba, Canada. Ungrazed meadows studied by Sowls included mowed and unmowed vegetation.

Nest Success

Nest success was calculated from 382 duck nests located on upland areas in all land-use categories of the study area during 1965-68 (Table 5). Nest success on ungrazed areas was twice as high as on grazed areas. Samples for hayland, cropland, and odd areas were too small for comparison, but the relatively poor success when com-

Table 5. Duck-nesting success by land use, Woodworth Study Area, 1965-1968 (all nests located on upland sites).

	Land Use					
	Ungrazed	Grazed	Odd Areas[a]	Hayland	Cropland	Totals
Nests hatched	61	17	4	1	1	84
Nests destroyed or deserted	160	105	24	4	5	298
Total nests	221	122	28	5	6	382
Percent hatched	28	14	14	20	17	22

[a] Includes isolated clumps of vegetation containing less than 5 acres and strips of cover 200 ft or less in width such as slough margins, fencerows, roadsides, and railroad right-of-ways. Most such areas were in an idle condition.

pared to the larger areas of undisturbed cover is probably indicative of a true difference.

I believe that actual nest success in ungrazed cover was even greater than the 100-percent difference the data show. Repeated nest searches with the cable-chain drag during 1967 made vehicle trails through the dense ungrazed cover. These trails remained throughout the winter of 1967–68 and nest searching activities during 1968 kept them open, increasing the extent of predation.

Evidence that red foxes used the vehicle trails as access routes into idle cover was obtained by placing 10 dust plots in the vehicle trails during 1968. Fox tracks were found during 43 percent of 56 exposures. Twenty plots were placed out of the vehicle trails in ungrazed areas for comparison, and fox tracks were found on only 8 percent of 60 exposures. Capel (1965:61) found that dummy nests located close to cattle trails suffered higher losses from predators than those located some distance away.

The adverse effect of vehicle trails in ungrazed cover was suggested by other information. In 1965 and 1966 prior to use of the drag, observed nesting success for 25 nests located in grazed areas was 20 percent compared to 46 percent for 46 nests found on idle lands. In 1967, the year the cable-chain drag was first used, observed success for 51 nests in grazed areas was 10 percent and nest success for 81 nests in ungrazed areas was 28 percent. In 1968, when cleared trails were present during the entire nesting season, 15 percent of 46 nests found in grazed areas hatched compared to 17 percent of 93 nests in ungrazed areas.

Another factor which may increase nest losses in ungrazed cover was reported by Hammond (Personal communication). He found that walking to nests in grazed areas did not increase predation rates as much as walking to nests in ungrazed cover.

Other workers have found higher nesting success in ungrazed than on grazed areas. Imler (Unpublished report on file at the Refuge) studied 377 duck nests on Crescent Lake National Wildlife Refuge, Nebraska. He found nesting success ranging from a low of 2 percent on summer grazed areas to a high of 21 percent in idle areas. The second highest success observed by Imler was on hayed and lightly grazed areas where 14 percent of the nests hatched. Anderson (1957:78) reported that 42.2 percent of 116 nests on idle land in California hatched while none of 7 nests on grazed land hatched. Glover (1956:41) found 24.4 percent nesting success on idle and lightly grazed areas in Iowa compared to only 10.5 percent success on heavily and moderately grazed areas.

Burgess et al. (1965) reported higher success on moderately grazed areas on Union Slough National Wildlife Refuge, Iowa, than on idle areas. Most of the idle cover studied, however, consisted of narrow strips or small clumps which this study (Table 5), as well as that of Moyle (1964), found to be especially vulnerable to predation. A more recent study in Iowa compared nest survival for 60 simulated nests in each of 3 land use categories (Weller, personal communication). On grazed lands survival was 10 percent, on lands grazed the previous year 17 percent, and on idle lands 30 percent.

Relatively low nest success (22 percent) was reported by Keith (1961:78) in 90 acres of ungrazed cover. This area contained about 54 water areas which occupied about a third of the land and resulted in a pattern of narrow bands of upland cover between water areas or between water areas

and the perimeter fence. He also noted that nests 25 ft or less from water were subject to higher predation than elsewhere on the study area. This, coupled with the pattern of upland cover, apparently made nests on this area especially vulnerable to predation. He observed comparatively high nesting success (38 percent) on another ungrazed area of 43 acres.

Errington (1963:187) pointed out that half to three-quarters of the nests of some birds may fail and still allow the breeding female to raise a brood, and Stoddard (1932:225) found that when observed nesting success was between 20 and 40 percent nearly all female bobwhite (*Colinus virginianus*) produced young because of renesting. On the Woodworth Study Area in 1966, when at least 50 percent of an estimated population of 633 pairs of ducks produced broods, the observed nesting success for 63 nests was 33 percent. In 1967, when at least 31 percent of an estimated population of 604 pairs of ducks produced broods, the observed nesting success for 152 nests was 20 percent. I suspect that the actual production during 1966 and 1967 was higher than the data indicate because all broods were not seen, but even so, the 14 percent observed nesting success on grazed areas found during this study would not maintain the duck population. The 28 percent success observed on idle areas would maintain and perhaps increase the population.

CONCLUSIONS AND RECOMMENDATIONS

In reviewing literature I was unable to find a single example where grazing or other cover removal activities increased waterfowl production. An outstanding example of the importance of undisturbed cover was reported by Mihelsons (1968:45) on three islands in a Latvian Lake where duck nesting increased from 6 to 9 times when mowing and grazing were discontinued. He found 5 to 7 mallard, shoveler, and pintail nests per year before grazing and mowing were stopped. This average increased to 40 nests after cessation of these activities. In his concluding remarks Mihelsons (1968:46) stated: "The above examples show that in places where breeding of ducks is desirable, economic activity is not permissible."

In our North Dakota study, higher pair populations, higher nest densities, and higher nesting success were found in ungrazed cover than in any other land-use type studied. Another important advantage of ungrazed cover was suggested by Leopold (1933). He noted that since most waterfowl begin to nest before new growth is suitable for nesting, the presence of residual cover from the previous year permits birds to begin nesting earlier and allows a longer time for renesting. Any activity which reduces residual cover from the previous year may adversely affect waterfowl production. Elimination of grazing and mowing activities will result in increased waterfowl production.

Other types of manipulations may result in further increases in waterfowl production. Rank cover, such as provided by the Soil Bank Program, appears to be an ideal objective. In Minnesota, Moyle (1961) demonstrated the value of Soil Bank cover to nesting ducks. Similarly, Duebbert (1969) found higher duck nest densities and success in rank, dense cover created under the Cropland Adjustment Program in South Dakota than on any other cover studied. Other wildlife species benefit from rank cover. Dahlgren (1967) reported that Soil Bank land was highly beneficial to ring-necked pheasants (*Phasianus colchicus*) in South Dakota. I found high populations of

sharp-tailed grouse (*Pedioecetes phasianellus*) on North Dakota Soil Bank and Cropland Adjustment fields, and the highest greater prairie chicken (*Tympanuchus cupido*) populations I have observed in North Dakota were on Soil Bank lands.

Based on the above findings I recommend:

1. That grazing and haying be discontinued as regular land-use practices on areas managed primarily for upland nesting ducks and upland game birds.

2. That dense, rank cover similar to Cropland Adjustment Program cover described by Duebbert (1969) be established on reverted cropland areas managed for duck production.

3. That periodic burning or soil disturbance to alter plant succession, fertilization, or combinations of these be tested as means of creating dense, rank cover.

4. That studies be continued to refine methods for creating and maintaining the most productive nesting cover for upland nesting ducks.

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